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CLAY AND SHALE RESOURCES OF MADISON, MONROE, AND ST. CLAIR COUNTIES, ILLINOIS

I. Edgar Odom

ABSTRACT

Thirty-three samples of clays and shales occurring in areas of Madison, Monroe, and St. Clair Counties were tested to determine their potential ceramic properties. Areas that contain minable shales or clays that may be suitable for the manufacture of red-fired clay products are located south of Fairview, south and east of Collinsville, north of Alton, north of O'Fallon, and near New Douglas and Grandfork. A clay that may be used for buff-fired clay products occurs south of Millstadt, and a clay having mineralogical properties suitable for the bonding of molding sand and perhaps iron ore pellets occurs below the Herrin (No. 6) Coal Member in Madison and St. Clair Counties.

Some shales located in areas near Fairview, Collinsville, and O'Fallon might also be used in the manufacture of lightweight aggregate.

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INTRODUCTION

The Madison, Monroe, and St. Clair Counties region is one of several areas in Illinois where urban growth has occurred at a rapid rate during the past ten years. This report locates and describes the clay and shale resources in these counties and suggests areas of potential deposits, in regions where dense urbanization has not yet taken place, that may be suitable for the manufacture of clay product building materials and other uses. Geologic information, including location, description, composition, and distribution of clays and shales, was compiled to help industry develop new deposits and to assist land-use planning organizations.

Representative samples of clays and shales accessible in outcrops in the three-county area were studied for this report. The locations of the deposits sampled are shown in figure 1.

STRATIGRAPHIC OCCURRENCE OF CLAYS AND SHALES

Pleistocene glacial deposits (drift) that range from a few feet to over 100 feet thick overlie the bedrock throughout most of Madison, Monroe, and St. Clair Counties. The glacial drift is dominantly pebbly, silty clay (till), and clayey silt (loess and alluvial deposits). The Pleistocene drift is chiefly calcareous and suitable only for products fired at low temperature. Two samples of glacial till are included in this study.

Bedrock formations outcropping along stream valleys in the area belong to the Pennsylvanian, Mississippian, and Ordovician Systems (fig. 2). Each of these systems contains clay or shale units interbedded with either

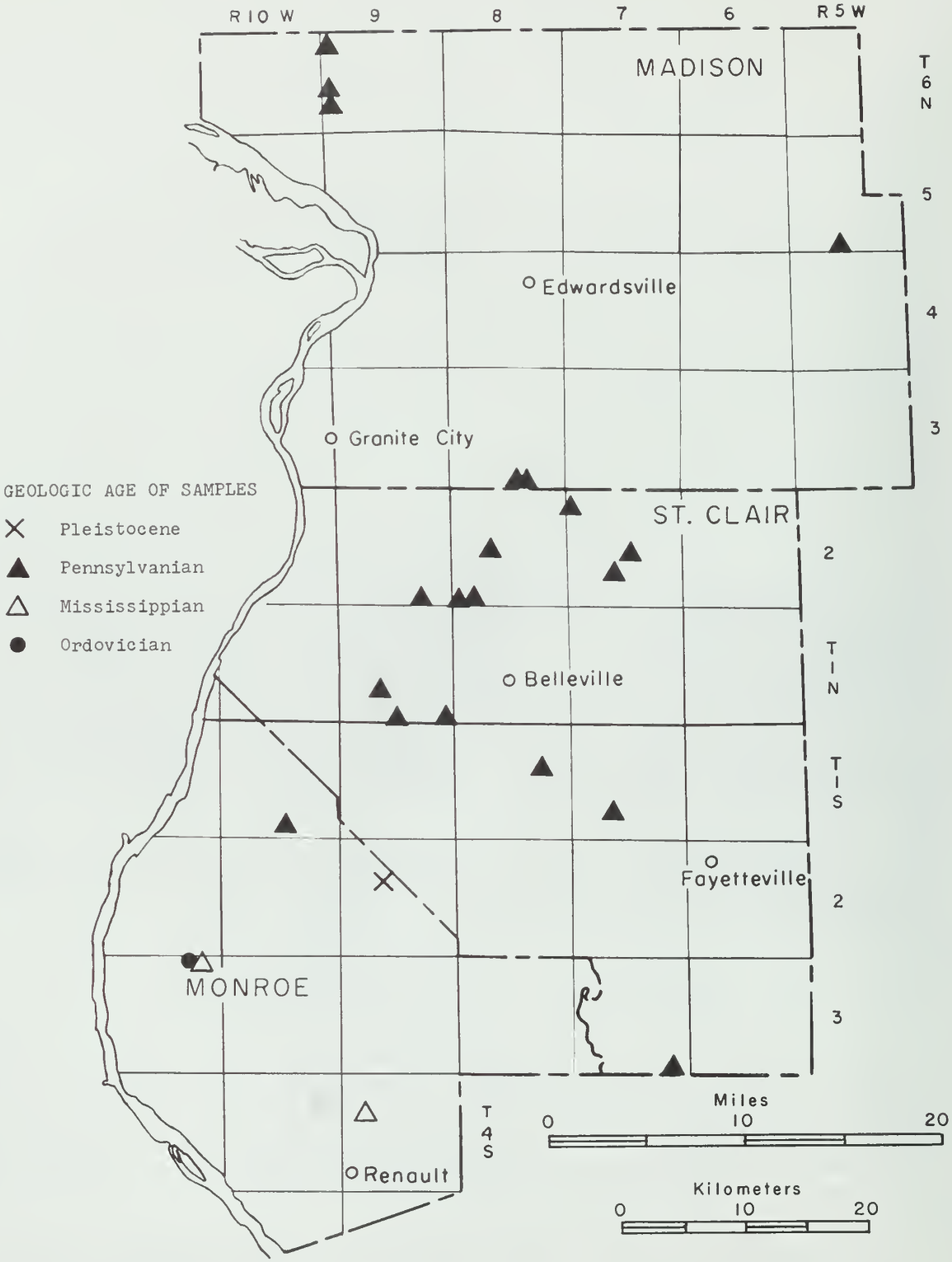

Fig. 1 - Location from which samples of clay and shale were taken for testing in Madison, Monroe, and St. Clair Counties.

limestones or sandstones. Most of the samples included in this study came from the Pennsylvanian System, but two shale samples from the Mississippian System and one shale sample from the Ordovician System also were tested.

MINERALOGY

The clay mineralogy of the clays and shales studied was determined by X-ray diffraction techniques. The amount of each clay mineral present in the less than 2-micron fraction was semiquantitatively evaluated. The important clay minerals in most of these samples are illite, chlorite, kaolinite, and a mixed-layer clay mineral consisting of an irregular interlayering of illite and montmorillonite. Two samples (2436 and 2452) were found to consist primarily of smectite (montmorillonite).

Nonclay minerals were not quantitatively evaluated, but previous tests indicate that quartz is the chief nonclay mineral present in these clays and shales. Minor amounts of pyrite, siderite, and gypsum also are sometimes present. Calcite is an abundant nonclay mineral in the glacial till samples, in the Mississippian Warsaw Shale, and in shales of the Ordovician Maquoketa Group.

TEST BAR FORMATION AND FIRING PROCEDURE

After each sample was air dried, ground, and water added, a laboratory extrusion machine was used to form good, solid test bars measuring 1 x 1 x 4.5 inches. The behavior of the clay during the extrusion procedure indicated its workability. Workability was rated as good, fair, or poor. The percentage of water necessary to extrude a test bar (water of plasticity) was determined from 1-inch cubes as the bars were formed. All bars were air dried and then placed in an oven at 230° F (110° C) overnight. A set of three test bars was made for each sample; one bar was fired to 1832° F (1000° C), another to 1922° F (1050° C), and the third to 2012° F (1100° C).

Linear shrinkage during drying (called "linear drying shrinkage") was determined for all bars, and total linear shrinkage was determined for each set of fired bars. The linear firing shrinkage, which is the difference between the total linear shrinkage after firing and the linear drying shrinkage, was then noted. The burning color was determined from the fired bars. Table 1 lists the deposits sampled, sample number, location, lithology, thickness of lithological units, drying and firing shrinkage, fired color, and clay mineral composition.

AREAS OF SHALE OR CLAY DEPOSITS OF ECONOMIC POTENTIAL

Based on firing tests and geology, several areas in Madison and St. Clair Counties may contain bedrock shale or clay deposits of possible economic interest (fig. 3). These areas contain shale deposits greater than 15

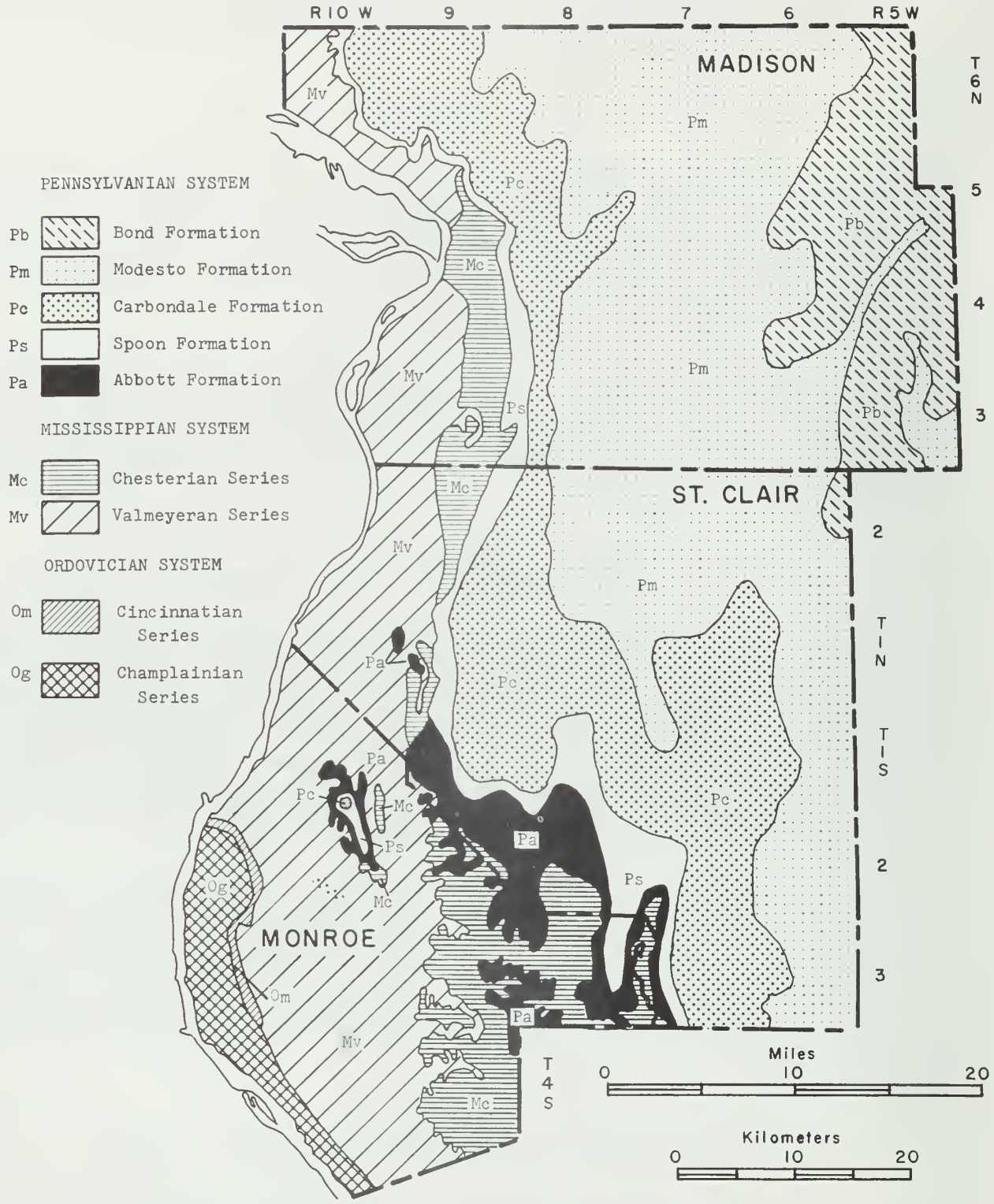

Fig. 2 - Generalized geologic map of Madison, Monroe, and St. Clair Counties.

feet thick or clay deposits less than 15 feet thick with special mineralogical properties. The boundaries of the suggested regions are generalized, and consideration of mining shale or clay in these areas should be preceded by a drilling program to determine the actual extent, characteristics, and thickness of the deposits.

Area 1—Township 1 S., Range 9 W. (fig. 3)

This area contains about 7 feet of clay (samples 2441 and 2447) occurring below the Colchester (No. 2) Coal Member that gives a buff color on firing. The orange color of test sample 2447 is believed to be due to iron concentration at the outcrop caused by oxidation of pyrite. Test sample 2441 was unweathered. This clay may be suitable for light colored fired clay products and for at least medium duty refractories.

In parts of this area, overburden thickness appears to be less than 20 feet.

Area 2—Townships 1, 2, and 3 N., Ranges 7 and 8 W. (fig. 3)

Area 2 contains a thick sequence of clays and shales occurring in the Modesto Formation above and below the Scottville Limestone Member. These deposits are generally suited for most types of red-burning clay products. Some clay or shale units in this area are also suitable for lightweight aggregate. Clays and shales occurring in the area south of Fairview are currently used for the manufacture of lightweight aggregate, and preliminary tests indicate that shale units in the area north of Fairview and O'Fallon and east of Collinsville also are suitable for lightweight aggregate.

Area 3—Township 6 N., Ranges 9 and 10 W. (fig. 3)

Shale in area 3 is in excess of 30 feet thick and may be used for red-burning clay products. In parts of this area overburden is less than 25 feet thick, but in other parts the overlying Pleistocene drift and Pennsylvanian sediments are in excess of 50 feet thick.

According to Parham and White (1963), an area in T. 5 N. and 6 N., R. 9 W. contains a clay that may be suitable for buff-burning clay products, but this region has been heavily urbanized in recent years.

Area 4—Townships 5 N. and 6 N., Range 5 W. (fig. 3)

This region is thought to contain shales of sufficient thickness for manufacture of red-burning clay products. The Richards Brick Company of Edwardsville, Illinois, is now mining shale for making red-burning brick from deposits one mile east of the Madison County's eastern boundary line, east of New Douglas. No outcrop samples suitable for testing were found in this area in Madison County, but geological information indicates that shales more than 15 feet thick may occur at a shallow depth.

TABLE 1—PLASTIC AND FIRING PROPERTIES OF CLAYS AND

Sample	Location 1/4	1/4	1/4	Sec.	T.	R.	Material	Thickness (ft)	Workability	Water of plasticity (%)	Linear drying shrinkage (%)
					MADISON COUNTY						
2434	SE	NW	SW	34	3N	8W	Sh	10	Good	17.8	2.2
2446	NE	NW	SE	34	3N	8W	Sh	6	Good	16.1	2.2
2453	SE	NW	SW	34	3N	8W	Sh	8	Good	18.4	4.4
2454	NE	SW	NW	7	6N	9W	Sh	4	Good	19.4	2.2
2455	SW	SW	SW	19	6N	9W	Sh	8	Good	23.0	4.4
2456	SW	SW	SE	30	6N	9W	Sh	24	Good	22.7	4.4
2462	SW	SW	SE	17	6N	9W	Till	25	Fair	11.9	2.2
2573**	SE	SW	SW	33	5N	5W	Sh	15	Fair	15.0	2.1
					MONROE COUNTY						
2457		SW	SE	34	1S	10W	Sh	5	Fair	17.7	4.4
2458	W½	SW	SW	2	3S	11W	Sh	30	Good	24.9	6.7
2459	S½	SE	NE	2	3S	11W	Sh	25	Good	25.9	4.4
2460	Center			17	4S	9W	Sh	6	Good	25.2	6.7
2461	NW	NE	NE	16	2S	9W	Till	10	Good	27.2	8.9
					ST. CLAIR COUNTY						
2431	SW	SW	NW	22	2N	7W	Sh	15+	Good	17.1	2.2
2432		NE½		35	2N	9W		5	Good	19.4	4.4
2433	SW	NE	NW	28	1S	7W	Sh	15	Good	14.9	2.2
2435	NW	NW	NW	34	1N	9W	Sh	5-10	Fair	17.5	2.2
2436		SE¼		14	1S	8W	Cl	4-5	Fair	22.6	4.4
2437	SE	NE	SW	32	2N	8W	Sh	4	Good	17.2	2.2
2438	SE	NE	SW	32	2N	8W	Sh	15	Good	18.7	2.2
2439	SE	NE	SW	32	2N	8W	Sh	20+	Good	16.0	2.2
2440	SW	NE	NW	28	1S	7W	Sh	15	Good	18.1	4.4
2442	NW	NE	SW	36	1N	9W	Sh	9+	Fair	19.6	2.2
2443	SW	NW	NE	31	2N	8W	Sh	4	Good	21.8	4.4
2444	SW	NW	NE	31	2N	8W	Sh	15	Good	19.3	2.2
2445	SW	NW	NE	31	2N	8W	Sh	15+	Good	18.3	2.2
2448	NW	NW	NW	21	2N	8W	Sh	15	Good	18.0	2.2
2449	NW	SW	SE	7	2N	9W	Sh	4	Good	18.6	2.2
2450	NE	SE	SE	28	2N	7W	Sh	10+	Fair	14.5	2.2
2452		S½		31	3S	7W	Cl	3-5	Good	30.0	6.7
2441	SW	SE	NE	28	1S	9W	Cl	2+	Good	21.0	4.4
2447	SW	SE	NE	28	1S	9W	Cl	5	Good	19.7	4.4
2451	NW	NW	NW	34	1N	9W	Cl	4	Good	20.5	6.7

I - Illite; C - Chlorite; K - Kaolinite; Mx - Mixed-layer material; Mt - Montmorillonite; Sh - Shal
T - Trace; * - Bloated; ** - Firing data by thermal gradient furnace method; and Cl - Clay.

SHALES IN MADISON, MONROE, AND ST. CLAIR COUNTIES

Firing temperature in degrees fahrenheit									Clay mineral composition (in parts in ten of diffraction effects)				
Linear firing shrinkage			Total linear shrinkage			Burning color							
1832°	1922°	2012°	1832°	1922°	2012°	1832°	1922°	2012°	I	C	K	Mx	Mt
MADISON COUNTY													
4.5	6.7	11.1	6.7	8.9	13.3	Red	Red	Red	3.8	1.7	2.1	2.4	
4.4	4.4	6.7	6.6	6.6	8.9	Red	Red	Red	4.5	1.2	2.5	1.9	
6.7	6.7	11.1	11.1	11.1	15.5	Red	Red	Red	3.3	T	4.8	1.9	
4.4	4.4	*	6.6	6.6	*	Red	Red	*	5.5	—	T	4.4	
6.7	8.9	8.9	11.1	13.3	13.3	Red	Red	Red	3.8	2.3	3.8	—	
6.7	8.9	8.9	11.1	13.3	13.3	Red	Red	Red	3.5	2.1	2.9	1.5	
*	*	*	*	*	*	Red	*	*	4.4	4.4	—	1.2	
2.1	7.4	*	4.2	9.5	*	Red	Red	*	3.7	1.9	3.1	1.3	
MONROE COUNTY													
4.4	6.7	*	8.8	11.1	*	Red	Red	*	3.3	4.5	—	2.2	
6.7	*	*	13.4	*	*	Red	*	*	4.9	2.6	—	2.5	
6.7	6.7	6.7	11.1	11.1	11.1	Red	Red	Red	5.0	1.1	—	3.9	
4.4	4.4	4.4	11.1	11.1	11.1	Red	Red	Red	2.7	—	3.0	4.3	
2.2	4.4	4.4	11.1	13.3	13.3	Red	Red	Red	1.9	—	4.3	3.8	
ST. CLAIR COUNTY													
2.2	4.4	8.8	4.4	6.6	11.1	Red	Red	Red	4.3	1.8	2.7	1.1	
4.4	*	*	8.8	*	*	Red	*	*	3.8	1.5	1.6	3.0	
2.2	2.2	6.7	4.4	4.2	8.9	Red	Red	Red	3.4	2.1	2.5	2.0	
0.0	4.4	4.4	2.2	6.6	6.6	Red	Red	Red	4.2	1.8	2.4	1.6	
6.7	*	*	11.1	*	*	Red	*	*	1.5	—	T	—	8.5
4.4	4.4	6.7	6.6	6.6	8.9	Red	Red	Red	3.7	2.4	2.6	1.7	
6.7	8.9	13.3	8.9	11.1	15.5	Red	Red	Red	5.0	1.4	1.9	1.7	
6.7	8.9	11.1	8.9	11.1	13.3	Red	Red	Red	3.8	2.6	2.1	1.5	
4.4	6.7	8.9	8.9	11.1	13.3	Red	Red	Red	5.0	2.1	2.1	1.7	
4.4	8.9	11.1	6.6	11.1	13.3	Red	Red	Red	3.7	2.2	3.1	1.0	
6.7	*	*	11.1	*	*	Red	*	*	3.9	5.0	—	1.1	
2.2	4.4	6.7	4.4	6.6	8.9	Red	Red	Red	3.5	2.4	3.1	1.3	
6.7	8.9	11.1	8.9	11.1	13.3	Red	Red	Red	4.4	2.6	2.3	0.7	
6.7	8.9	11.2	8.9	11.1	13.4	Red	Red	Red	4.3	2.1	3.2	1.3	
4.4	8.9	8.9	6.6	11.1	11.1	Red	Red	Red	3.7	2.5	3.1	0.7	
0.0	2.2	4.4	2.2	4.4	6.7	Red	Red	Red	4.0	1.2	3.3	1.5	
2.2	*	*	8.9	*	*	Red	*	*	—	—	—	0.5	9.5
2.2	6.7	6.7	6.6	11.1	11.1	Buff	Gray	Gray	2.1	0.6	5.2	2.0	
2.2	6.7	6.7	6.6	11.1	11.1	Orange	Orange	Choc-olate	1.0	—	7.8	1.3	
0.0	2.2	4.4	6.7	8.9	13.3	Orange	Orange	Buff	—	—	9.0	1.0	

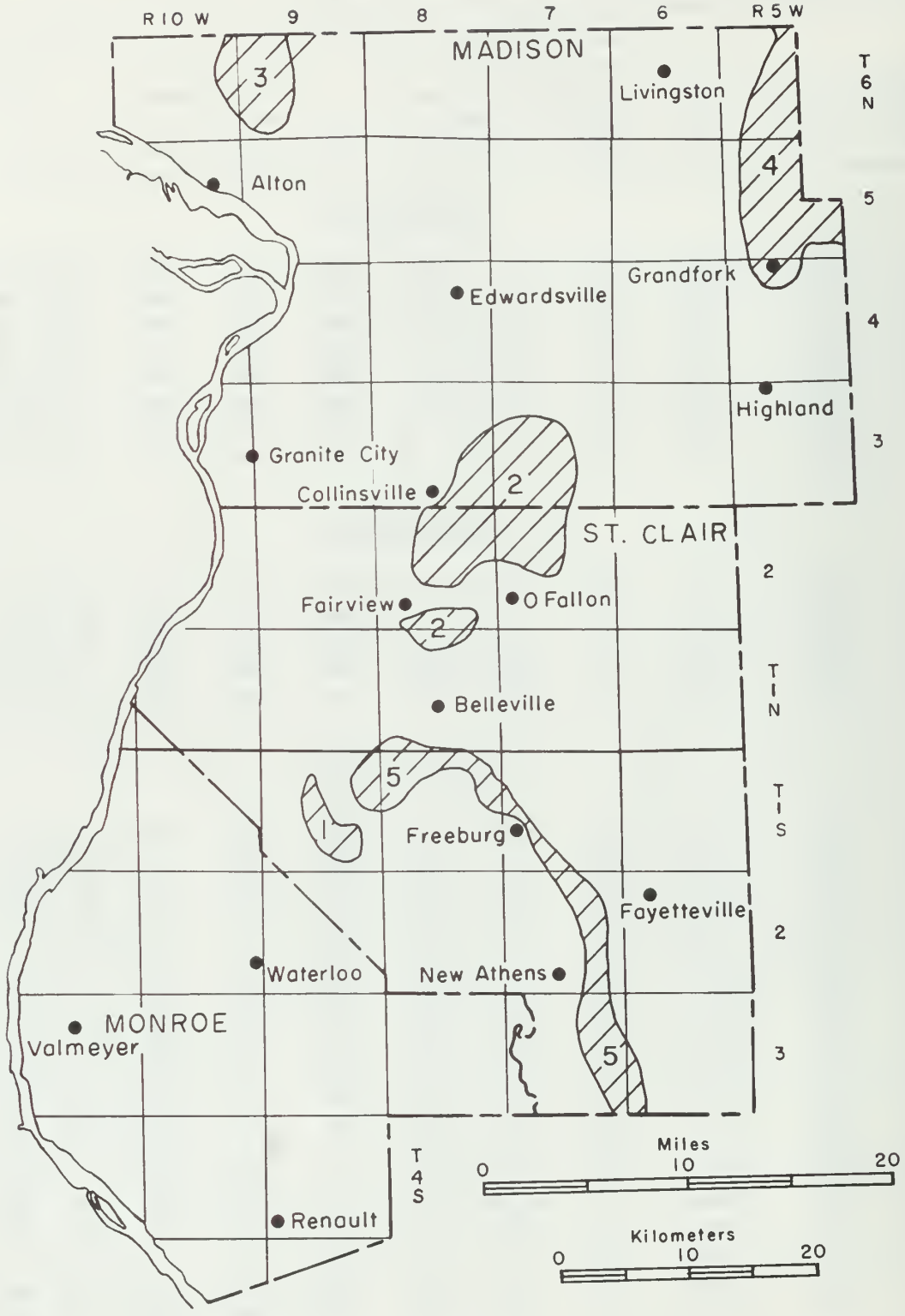

Fig. 3 - Areas thought to contain bedrock shale or clay deposits of economic potential.

Area 5—Townships 1, 2, and 3 S., Ranges 6, 7, 8 and 9 W. (fig. 3)

The potential clay resource in area 5 is a clay, 4 to 5 feet thick, occurring below the Herrin (No. 6) Coal Member. At the two locations studied, this clay consists primarily of montmorillonite, but previous studies (White, 1956; Odom and Parham, 1968) show that in other locations this clay consists primarily of mixed-layer material, illite, and some kaolinite. Clay material of this nature has been used in the bonding of molding sands and is probably also suited for bonding of iron ore pellets.

The mining of this clay may be more feasible if conducted in association with coal mining because of the clay's thinness and the thickness of overburden. The clay is present below the Herrin (No. 6) Coal Member wherever this coal occurs in St. Clair and Madison Counties. The area shown in figure 3 locates some strip coal mining that is now in progress or that is likely to occur in the immediate future.

The stratigraphic position and geologic descriptions of the deposits sampled are listed alphabetically, by county, in the Appendix.

SUMMARY AND CONCLUSIONS

Areas in Madison and St. Clair Counties near Alton, Collinsville, Fairview, Grandfork, and O'Fallon contain clay and shale deposits with suitable mineralogical and physical properties for use in making red-burning structural clay products, drain tile, and pottery. Clays and shales south of Fairview are at present being used for making lightweight aggregate, and it is suggested that similar deposits north of Fairview and near Collinsville are also suitable for lightweight aggregate.

An area containing a light-burning clay, which may be used for medium duty refractories, occurs in St. Clair County near Millstadt.

A clay having mineralogical properties desirable for bonding of molding sand and possibly for iron ore pellets underlies the Herrin (No. 6) Coal Member. The Herrin (No. 6) Coal Member occurs over a large area of Madison and St. Clair Counties and is at present being uncovered in several strip mining operations in the area.

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Parham, W. E., and W. A. White, 1963, Buff-burning clay resources of southwestern and southern Illinois: Illinois Geol. Survey Circ. 352, 23 p.

White, W. A., 1956, Underclay squeezes in coal mines: Mining Eng., v. 8, no. 10, Oct., p. 1024-1028.

APPENDIX

GEOLOGIC DESCRIPTIONS OF OUTCROPS SAMPLED

MADISON COUNTY

SAMPLE 2456

SW SW SE sec. 30, T. 6 N., R. 9 W.

	Thickness (ft)	(in)
QUATERNARY SYSTEM		
Pleistocene Series		
Loess	15+	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Shale, gray, silty (sample 2456)	24+	
Shale, black, fissile	1	2

SAMPLE 2455

SW SW SW sec. 19, T. 6 N., R. 9 W.

QUATERNARY SYSTEM	
Pleistocene Series	
Loess	20+
PENNSYLVANIAN SYSTEM	
Kewanee Group	
Carbondale Formation	
Sandstone, fine grained, micaceous, plant fragments	2
Shale, dark gray, sandy, micaceous (upper portion of section sampled in sec. 30, T. 6 N., R. 9 W.) (sample 2455)	8

SAMPLE 2453, 2434

SE NW SW sec. 34, T. 3 N., R. 8 W.

QUATERNARY SYSTEM	
Pleistocene Series	
Loess	15+

	Thickness (ft)	(in)
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Limestone (Scottville Member) fine grained, very fossiliferous	1	
Shale, gray, silty, micaceous, few sandstone lenses (sample 2453)	8	
Shale, gray, silty, micaceous, large sandstone body at top near middle of section (sample 2434)	10	

SAMPLE 2454

NE SW NW sec. 7, T. 6 N., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess and till	30+	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Limestone, gray, nodular	1	
Shale, gray, calcareous	1	6
Shale, dark gray, fissile, occasional calcareous nodules (sample 2454)	3	7

SAMPLE 2446

NE NW SE sec. 34, T. 3 N., R. 8 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	20+	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Sandstone, fine grained, thinly to massively bedded	2	
Shale, brown, very sandy, micaceous (sample 2446)	5	6
Limestone (Scottville Member)	1	

SAMPLE 2462

SW SW SE sec. 17, T. 6 N., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	15+	
Till, gray, pebbly, calcareous (sample 2462)	25+	

SAMPLE 2573

SE SW SW sec. 33, T. 5 N., R. 5 W.

	Thickness (ft)	(in)
QUATERNARY SYSTEM		
Pleistocene Series		
Loess and till	5	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Bond Formation		
Limestone, gray, fossiliferous	3	
Shale, black, fissile	1	
Shale, gray, thinly bedded, concretions (sample 2573)	15	

MONROE COUNTY

SAMPLE 2457

SW SE sec. 34, T. 1 S., R. 10 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess and alluvium	5+	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Clay, contains limestone nodules	2	
Shale, greenish, sandy. Base not exposed (sample 2457)	5	

SAMPLE 2458

W½ SW SW sec. 2, T. 3 S., R. 11 W.

MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Fern Glen Formation		
Limestone, coarse grained, fossiliferous		
ORDOVICIAN SYSTEM		
Cincinnatian Series		
Maquoketa Group		
Scales Shale Formation		
Shale, gray, calcareous (sample 2458)	30	

SAMPLE 2459

S½ SE NE sec. 2, T. 3 S., R. 11 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	10+	
MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Warsaw Shale		
Shale, gray, contains several 1-in limestone beds (sample 2459)	25+	

SAMPLE 2460

Center sec. 17, T. 4 S., R. 9 W.

	Thickness (ft)	(in)
QUATERNARY SYSTEM		
Pleistocene Series		
Loess	10+	
MISSISSIPPIAN SYSTEM		
Chesterian Series		
Renault Formation		
Sandstone, fine grained	4	
Shale and sandstone. Base not exposed (sample 2460) . . .	6	

SAMPLE 2461

NW NE NE sec. 16, T. 2 S., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	10	
Till, pebbly, oxidized (sample 2461)	10	
MISSISSIPPIAN SYSTEM		
Valmeyeran Series		
Aux Vases Formation		
Sandstone, fine grained, massively bedded	2+	

ST. CLAIR COUNTY

SAMPLE 2431

SW SW NW sec. 22, T. 2 N., R. 7 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	7	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Shale, massively to thinly bedded, silty, micaceous. Base not exposed (sample 2431)	15+	

SAMPLE 2432

NE$\frac{1}{2}$ sec. 35, T. 2 N., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	50	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		

	Thickness (ft)	(in)
Underclay, greenish gray to dark gray plastic. Top not exposed (sample 2432)	5	
Brereton Limestone Member. Base not exposed	5	

SAMPLE 2433, 2440

SW NE NW sec. 28, T. 1 S., R. 7 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	6	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Sandstone, fine grained, massively to thinly bedded	3	
Shale, brownish to dark gray, sandy, micaceous (sample 2240)	15	
Shale, dark gray, silty, micaceous. Base not exposed (sample 2433)	15	

SAMPLE 2435, 2451

NW NW NW sec. 34, T. 1 N., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	10	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Shale, red, purple, and green, silty (sample 2435)	5-10	
Sandstone, gray, thinly bedded, micaceous, thin greenish silty layers	15	
Colchester (No. 2) Coal Member		2
Spoon Formation		
Clay, dark gray, sandy to silty (sample 2451)	4	
Siltstone, light gray, cross-bedded. Base not exposed	6+	

SAMPLE 2436

SE sec. 14, T. 1 S., R. 8 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess and till	20	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Shale, greenish	2	
Limestone, massive	6	
Shale, greenish	4	

	Thickness (ft)	(in)
Brereton Limestone Member, dark gray, fine grained, fossiliferous	3-4	
Shale, black, fissile	1	
Herrin (No. 6) Coal Member	5	
Clay, dark gray, calcareous, many plant impressions (sample 2436)	4-5	
Limestone, fine grained, nodular		3

SAMPLE 2437, 2438, 2439

SE NE SW sec. 32, T. 2 N., R. 8 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess and till	30+	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Shale, brown to dark gray, silty, few thin sandstone beds, few ironstone concretions (sample 2438)	15	
Sandstone, fine grained, thinly bedded, shaly	3	
Shale and sandstone, blue-gray, sandy, micaceous	3	
Shale, blue-gray, silty, micaceous (sample 2437)	4	
Shale, dark gray, blocky structure. Base not exposed (sample 2439)	20+	

SAMPLE 2441, 2447

SW SE NE sec. 28, T. 1 S., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	5	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Limestone, nodular, massive, fossiliferous	2	
Shale, gray, thinly bedded, calcareous	1	
Limestone, nodular, massive	1	
Shale, dark gray to black, thinly bedded	3	
Colchester (No. 2) Coal Member	1	8
Spoon Formation		
Clay, massive, heavily oxidized and iron stained (sample 2447)	5	
Clay, massive, plastic, unoxidized, pyritic. Base not exposed (sample 2441)	2	

SAMPLE 2442

NW NE SW sec. 36, T. 1 N., R. 9 W.

	Thickness (ft)	(in)
QUATERNARY SYSTEM		
Pleistocene Series		
Loess	5+	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Sandstone, fine grained, thinly bedded	1	
Shale, green, thinly bedded, contains sandstone lenses and ironstone concretions. Base not exposed (sample 2442) . .	9+	

SAMPLE 2443, 2444, 2445

SW NW SE sec. 31, T. 2 N., R. 8 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	30+	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Sandstone, fine grained, shaly, micaceous	15+	
Shale, light gray to dark gray, blocky to thinly laminated, silty, few ironstone concretions (sample 2443)	4	
Scottville Limestone Member, coarse, fossiliferous	2	
Shale, dark gray, blocky, nonsilty, few ironstone concretions. Base not exposed (sample 2444 upper 5 ft) (sample 2445 lower 10 ft)	30+	

SAMPLE 2448

NW NW NW sec. 21, T. 2 N., R. 8 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	10+	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Shale, dark gray, silty, micaceous, discontinuous sandstone lenses in middle part. Base not exposed (sample 2448)	15+	

SAMPLE 2449

NW SW SE sec. 7, T. 2 N., R. 9 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	5	

	Thickness (ft)	(in)
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Limestone, light gray, coarse crystalline, fossiliferous . .	3	
Shale, dark gray, silty, micaceous. Base not exposed (sample 2449)	4	

SAMPLE 2450

NE SE SE sec. 28, T. 2 N., R. 7 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess	4	
PENNSYLVANIAN SYSTEM		
McLeansboro Group		
Modesto Formation		
Sandstone, fine grained, massive	3	
Shale and interbedded sandstone. Base not exposed (sample 2450)	10+	

SAMPLE 2452

S½ sec. 31, T. 3 S., R. 7 W.

QUATERNARY SYSTEM		
Pleistocene Series		
Loess and till	25	
PENNSYLVANIAN SYSTEM		
Kewanee Group		
Carbondale Formation		
Brereton Limestone Member, dark gray, fine grained	2	
Shale, black, fissile	0-1	
Herrin (No. 6) Coal Member	5+	
Clay, light gray to dark gray, massive (sample 2452)	3-5	

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